

## The History of Cardiac Catherization

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**Four major events took place that eventually led to the development of the cardiac catheterization techniques employed today. These were the development of techniques for measuring intracardiac physiologic events in animals, the application of these techniques to humans, the development of coronary angiography and the development of catheter-based procedures.**

In 1844, Claude Bernard inserted a mercury thermometer into the carotid artery of a horse and advanced it through the aortic valve into the left ventricle to measure blood temperature. He adapted this experiment over the next forty years for measuring intracardiac pressures in a variety of animals. It is because of his work that the use of catheters became the method of standard for physiologists in the study of cardiovascular hemodynamics. Another major step in the development of cardiac catheterization was taken by Adolph Fick in 1870. His famous, but brief note on the calculation of blood flow is the basis for today's procedures.

Among the earliest published descriptions of human catheterization were those done by Fritz Bleichroeder, E. Unger and W. Loeb in 1912. They were among the first to insert catheters into the blood vessels without x-ray visualization.

Interest in catheterization was also stimulated with the advent of chemotherapy. Early chemotherapy required the injection of drugs directly into the central circulation. Bleichroeder inserted catheters into dog arteries and assessed the effects after leaving them in place for several hours. He reported no complications or clots.

In 1929, a German surgical trainee, Werner Forssmann, experimented on a human cadaver and realized how easy it was to guide a urological catheter from an arm vein into the right atrium. He went so far as to dissect the veins of his own forearm and guide a urological catheter into his right atrium using fluoroscopic control and a mirror. With the catheter in place, he walked to the x-ray room with no ill effects to have his chest x-rayed. This made Forssmann the first to document right heart catheterization in humans using radiographic techniques. In return, he was fired from his position at the hospital and won the Nobel Prize in 1956.

In 1930, after having advanced a urethral catheter through a cannula into an arm vein of a patient, Jimenez Diaz and Sanchez Cuenca confirmed with x-ray its location in the right atrium.

In the early 1940's, however, Andre Cournand, working in New York with Hilmert Ranges and Dickinson Richards, began utilizing right heart catheterization on a regular basis in the undertaking of a comprehensive investigation of cardiac function in both normal and diseased patients. In 1956, Cournand, Richards and Forssmann shared the Nobel Prize in physiology and medicine for their contributions to the advancement of cardiac catheterization.

By 1947, H. A. Zimmerman had developed a completely intravascular technique for human left heart catheterization. Zimmerman and his associates performed a simultaneous catheterization of both right and left heart. They are credited with the development of combined cardiac catheterization.

In 1953, Seldinger developed a percutaneous approach for the introduction of catheters for both right and left heart catheterization. By 1960, the Seldinger technique had been adapted by Charles Dotter and Goffredo Gensini for the use of special catheters that were more practical for left heart catheterization. In the 1950's, diagnostic catheterization became established as the best method for confirmation of clinical findings prior to cardiac surgery for valvular or congenital heart disease.



During the late 1940's and early 1950's, there were a number of indirect methods developed to enhance the visualization of the coronary arteries. These included the flooding of the aortic root with a large quantity of contrast material that flowed into the coronary arteries.

In 1958 Mason Sones began the development of a selective coronary angiography procedure using image amplification and optical amplification with high speed cinetechnique. Sones developed a catheter to enter selectively the coronary arteries. It had a relatively rigid body for torque control and a tapered tip which made it easier to curve as it was advanced against the left aortic valve leaflet. After demonstrating that this procedure was safe, selective coronary angiography became the standard of reference in the diagnosis of coronary artery disease.

In the 1950's William Raskind developed a procedure which was successful in enhancing pulmonary blood flow by creating or enlarging an atrial septal defect using a balloon.

During the years to follow, a number of advancements were made including the development of the self-guiding catheter by Lategola and Rahn and the balloon flotation catheter by Swan and Ganz. Percutaneous Transluminal Coronary Angioplasty (PTCA) was first conceived and reported by Dr. Dotter and Dr. Judkins in 1964. Dr. Andreas Gruentzig invented the first experimental PTCA balloon in 1974.

The field of cardiac catheterization continues to evolve and expand into more and more therapeutic procedures brought about by advances in the fields of material science and miniaturization.

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